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P·S· Population Studies

An evaluation of population estimates

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The Bureau of Economic and Business Research (BEBR) has made annual population estimates for every city and county in Florida since 1972. These population estimates have been used for many purposes, including the allocation of state revenue-sharing funds and the planning of many public and private investments. With so many critical decisions being affected by these estimates, it is important to carefully evaluate their precision, bias and consistency. The recent publication of 1980 census results makes possible such an evaluation. This bulletin will assess the accuracy of the BEBR population estimates, focusing on the size and direction of error, sources of error and comparisons with other estimation methodologies.

Size and direction of errors

Table 1 summarizes the population estimation errors for the 389 incorporated cities and towns in Florida. Several conclusions can be drawn from this table. First, there is a strong negative relationship between size of place and level of error: the larger the population size, the smaller the average percentage error. For places with fewer than 1,000 people in 1970, the average estimation error is 27.4 percent; for places between 1,000 and 9,999 the average error is 10.4 percent; and for places with greater than 10,000 the average error is 4.9 percent. Furthermore, more than half of the small cities have large errors (greater than 15 percent) while none of the largest cities have large errors. Conversely, more than half of the largest cities have small errors (less than 5 percent) while only a few smaller cities have small errors.

Second, the estimates are almost equally divided between under- and over-estimates. The estimates are too high in 196 cities and too low in 193. These figures indicate a virtually complete lack of bias in the estimating technique for cities. Furthermore, this characteristic generally holds true for all size-of-place categories. There is no correlation between size of place and direction of bias.

Comparison with other estimation methodologies

The overall average error for cities is 15.5 percent. Does this

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Table 1.—Errors in population estimates for cities

Size - 1970	Number	Error (percent)	Hi	Lo	Distribution of errors (percent) Less than 5	5-10	10-15	15+
50,000+	13	3.7	6	7	11	0	2	0
25,000-49,999	15	4.1	6	9	10	5	0	0
10,000-24,999	39	5.6	25	14	21	12	4	2
2,500-9,999	116	8.1	62	54	46	35	20	15
1,000-2,499	67	14.4	32	35	21	15	10	21
500-999	56	20.4	28	28	13	12	3	28
100-499	65	27.8	29	36	6	12	12	35
Less than 100	18	47.8	8	10	1	1	0	16
Total	389	15.5	196	193	129	92	51	117

level of error indicate a good, bad or average performance? How does one evaluate the performance of a population estimation technique? While there are not any universally accepted standards for judging errors, the BEBR estimates can be evaluated by comparing their errors with those produced by other estimation methods.

Table 2 provides the basis for such a comparison, showing the average errors for counties produced by the BEBR estimates and the errors produced by two methods used by the U.S. Bureau of the Census. (City estimates produced by the U.S. Bureau of the Census are not yet available.) The top half of this table shows average absolute percentage errors (sign excluded), providing measures of the precision of the three methods. The bottom half shows average algebraic percentage errors (sign included), providing measures of the bias of the methods.

The U.S. Bureau of the Census uses three different methods for making county population estimates. The numbers shown here are from the preliminary estimates produced by Component II (COMP) and Ratio Correlation (REGR). Estimates produced by the third method, Administrative Records, are not yet available.

Table 2 shows the BEBR estimates to be better than those produced by the U.S. Bureau of the Census. The BEBR estimates are more precise, as indicated by the overall average absolute error of 5.3 percent, compared to 7.8 and 6.3 percent for the other two methods. More importantly, the BEBR estimates are considerably less biased, as indicated by the overall average algebraic error of -2.9 percent, compared to -7.1 and -5.4 percent for the other two methods. Furthermore, at the state level the BEBR error is only -2.6 percent, compared to -6.4 and -6.3 percent for the other two methods. According to all three criteria, the BEBR estimates perform better than the estimates produced by the U.S. Bureau of the Census.

Table 2.—Errors in population estimates for counties

Size - 1970	Number	BEBR	COMP	REGR
Average absolute percentage error				
Less than 15,000	25	5.5	7.5	5.0
15,000-49,999	18	7.1	8.7	8.3
50,000-99,999	9	4.6	8.9	7.3
100,000+	15	3.1	6.6	5.6
Total	67	5.3	7.8	6.3
Average algebraic percentage error				
Less than 15,000	25	-1.1	-5.8	-2.6
15,000-49,999	18	-5.8	-8.5	-8.1
50,000-99,999	9	-3.9	-8.7	-7.2
100,000+	15	-1.8	-6.5	-5.6
Total	67	-2.9	-7.1	-5.4

A few words concerning the apparent downward bias in the BEBR county population estimates may be in order. The errors reported here are the differences between the estimates and the 1980 Census enumeration. However, an evaluation of the census itself has not yet been made. Certainly it contains some errors, as all large censuses do. Most important for evaluating estimation bias is the degree of undercount in the census. In 1970 the undercount was estimated as 2.5 percent for the nation as a whole and 5 to 6 percent for Florida. Preliminary evidence indicates that the undercount may have been considerably smaller in 1980 than it was in 1970. If this situation proves to be true, the underestimate of population shown in Table 2 may be caused primarily by a more nearly complete census count rather than by a downward bias in the estimation methodology.

Table 3.--Errors in estimates of households and PPH for counties

Size - 1970	Number	Households	PPH
Average absolute percentage error			
Less than 15,000	25	7.5	4.9
15,000-49,999	18	6.3	5.8
50,000-99,999	9	4.6	5.1
100,000+	15	4.0	3.2
Total	67	6.0	4.8
Average algebraic percentage error			
Less than 15,000	25	3.9	-4.6
15,000-49,999	18	-1.5	-1.8
50,000-99,999	9	-0.7	-3.2
100,000+	15	0.8	-2.5
Total	67	1.1	-3.2

Sources of error

The BEBR estimates are produced using the housing unit method of population estimation. The two main components of this method are the number of households and the average number of persons per household (PPH). These two components must therefore be the primary sources of error in the BEBR population estimates.

Table 3 shows the average absolute and algebraic percentage errors for household and PPH estimates for counties. Although the differences in absolute errors are not large, the errors for estimates of households are somewhat larger than the errors for estimates of PPH. That is, estimates of PPH are slightly more precise than estimates of households, on the average. Large differences occur in the algebraic errors. Estimates of households have a small upward bias, as indicated by the overall average algebraic error of 1.1 percent. Estimates of PPH, on the other hand, have a considerably larger downward bias, as indicated by the overall average algebraic error of -3.2 percent. While the estimates of households and PPH share fairly equally in determining the precision of the BEBR county population estimates, the small downward bias seen in Table 2 is caused primarily by the estimates of PPH.

Summary and conclusions

The 1980 population estimates produced by the BEBR were 2.6 percent below the 1980 Census count at the state level, with an average error of 5.3 percent for counties and 15.5 percent for cities (4.9 percent for cities with greater than 10,000 population). For cities there is virtually no evidence of bias, as 196 estimates were too high and 193 too low. For counties there is some indication of a downward bias, as 23 estimates were too high and 44 too low, with an overall average algebraic error of -2.9 percent. This downward bias is caused primarily by the estimates of PPH, which had an average algebraic error of -3.2 percent compared to 1.1 percent for estimates of households.

We believe this performance is quite good. Florida is a very difficult state in which to estimate population. Growth rates are very high; many people live in the state for only part of the year; large numbers of legal and illegal foreign immigrants enter the state and the age and ethnic structure of the population is changing very rapidly. These factors add to the uncertainty of population estimates. Yet the BEBR estimation procedures

performed very well and were more precise and less biased than the estimates produced by the U.S. Bureau of the Census, the nation's leading practitioner of demographic techniques. All of this evidence reflects very favorably on the BEBR estimation procedures.

Of course, improvements in the BEBR estimation procedures can still be made. Some errors, particularly for small towns, are much too large. New indicators of households can be devised. Better estimates of PPH can be developed. Measures of seasonality must be explored. Alternatives to the housing unit method can be tested. A great deal remains to be done to improve the quality of local population estimates. But given the current state of the art and the complexity of Florida population dynamics, the techniques used and the estimates produced by the BEBR have stood up very well in testing against 1980 Census results.

Note: The 1980 Census counts used in this evaluation are those reported by the U.S. Bureau of the Census in April, 1981. Since that time, a number of adjustments to these counts have been made. These adjustments are very small at the state and county levels, but are sometimes significant for small towns. While the adjusted counts were not available at the time this empirical analysis was performed, their use in future analysis is not expected to have a large effect on the results reported here.

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